

WHAT IS CLAIMED IS:

1 1. A variable compression ratio system for an internal
2 combustion engine, comprising:

3 a variable compression ratio mechanism for continuously
4 varying a compression ratio of the internal combustion
5 engine, the variable compression ratio mechanism including a
6 control shaft rotatably moveable to a rotational position
7 corresponding to the compression ratio;

8 a hydraulic actuator driving the control shaft to the
9 rotational position depending on operating conditions of the
10 internal combustion engine;

11 a hydraulic pressure source mechanically driven by the
12 internal combustion engine to produce a hydraulic pressure
13 supplied to the hydraulic actuator; and

14 hydraulic control means for variably controlling the
15 hydraulic pressure supplied to the hydraulic actuator on the
16 basis of the operating conditions of the internal combustion
17 engine.

1 2. The variable compression ratio system as claimed in
2 claim 1, wherein the hydraulic control means comprises a
3 controller programmed to determine a target hydraulic
4 pressure by selecting a larger one of a first hydraulic
5 pressure required for satisfying responsivity of the control
6 shaft upon varying the compression ratio of the internal
7 combustion engine and a second hydraulic pressure required
8 for holding the control shaft at the rotational position to
9 maintain the compression ratio of the internal combustion
10 engine.

1 3. The variable compression ratio system as claimed in
2 claim 2, wherein the hydraulic control means comprises a
3 selector valve electronically connected to the controller

4 and operated to switch supply of the hydraulic pressure to
5 the hydraulic actuator, the selector valve being disposed
6 between the hydraulic actuator and the hydraulic pressure
7 source, the controller being programmed to variably control
8 a hydraulic pressure upstream of the selector valve based on
9 the operating conditions of the internal combustion engine.

1 4. The variable compression ratio system as claimed in
2 claim 3, further comprising a pressure sensor operative to
3 detect the hydraulic pressure upstream of the selector valve
4 and transmit a signal indicative of the detected hydraulic
5 pressure, the controller being programmed to determine the
6 hydraulic pressure supplied to the hydraulic actuator on the
7 basis of the signal.

1 5. The variable compression ratio system as claimed in
2 claim 4, wherein the hydraulic control means comprises a
3 variable relief valve disposed between the selector valve
4 and the hydraulic pressure source, the variable relief valve
5 being electronically connected to the controller and
6 operated to release an amount of hydraulic fluid discharged
7 from the hydraulic pressure source, the controller being
8 programmed to determine the amount of hydraulic fluid to be
9 released through the variable relief valve on the basis of
10 the signal.

1 6. The variable compression ratio system as claimed in
2 claim 4, wherein the hydraulic control means comprises a
3 check valve disposed between the selector valve and the
4 hydraulic pressure source and a hydraulic accumulator
5 disposed between the check valve and the selector valve, the
6 controller being programmed to variably control a hydraulic
7 pressure within the hydraulic accumulator.

1 7. The variable compression ratio system as claimed in
2 claim 6, wherein the hydraulic control means comprises an
3 unloading valve disposed between the hydraulic pressure
4 source and the check valve, the unloading valve being
5 electronically connected to the controller and operated to
6 release the hydraulic pressure discharged from the hydraulic
7 pressure source when the hydraulic pressure within the
8 hydraulic accumulator is more than a predetermined hydraulic
9 pressure.

1 8. The variable compression ratio system as claimed in
2 claim 6, wherein the hydraulic control means comprises a
3 clutch mechanism for coupling the hydraulic pressure source
4 to the internal combustion engine, the clutch mechanism
5 being electronically connected to the controller and
6 operated to prevent the coupling between the hydraulic
7 pressure source and the internal combustion engine when the
8 hydraulic pressure within the hydraulic accumulator is more
9 than a predetermined hydraulic pressure.

1 9. The variable compression ratio system as claimed in
2 claim 8, wherein the operating conditions comprise engine
3 speed, the controller is programmed to control the
4 hydraulic pressure supplied to the hydraulic actuator so as
5 to minimize the compression ratio of the internal combustion
6 engine and operate the clutch mechanism to prevent the
7 coupling between the hydraulic pressure source and the
8 internal combustion engine, when the engine speed exceeds a
9 predetermined speed.

1 10. The variable compression ratio system as claimed in
2 claim 1, wherein the internal combustion engine has a
3 supercharger.

1 11. The variable compression ratio system as claimed in
2 claim 1, wherein the variable compression ratio mechanism
3 comprises an upper link having one end coupled to a piston
4 via a piston pin, a lower link pivotally coupled to the
5 upper link and pivotally supported on a crankshaft via a
6 crankpin, and the control shaft having one end pivotally
7 coupled to the lower link and an opposite end pivotally
8 supported on an eccentric cam disposed on the control shaft.

1 12. A method for controlling a variable compression ratio
2 system for an internal combustion engine, the variable
3 compression ratio system including a variable compression
4 ratio mechanism for continuously varying a compression ratio
5 of the internal combustion engine, a hydraulic actuator
6 driving the variable compression ratio mechanism, and a
7 hydraulic pressure source mechanically driven by the
8 internal combustion engine to produce a hydraulic pressure,
9 the hydraulic actuator being supplied with the hydraulic
10 pressure from the hydraulic pressure source via a hydraulic
11 passage extending therebetween, the method comprising:
12 detecting operating conditions of the internal
13 combustion engine;
14 determining a predetermined hydraulic pressure to be
15 supplied to the hydraulic actuator on the basis of the
16 detected operating conditions of the internal combustion
17 engine;
18 detecting a hydraulic pressure within the hydraulic
19 passage; and

20 controlling the hydraulic pressure supplied to the
21 hydraulic actuator to the predetermined hydraulic pressure
22 on the basis of the detected hydraulic pressure within the
23 hydraulic passage.

1 13. The method as claimed in claim 12, wherein the
2 predetermined hydraulic pressure comprises a target
3 hydraulic pressure determined by selecting a larger one of a
4 first hydraulic pressure required for satisfying
5 responsivity of the variable compression ratio mechanism
6 upon varying the compression ratio of the internal
7 combustion engine and a second hydraulic pressure required
8 for holding the variable compression ratio mechanism at an
9 operational position to maintain the compression ratio of
10 the internal combustion engine.

1 14. The method as claimed in claim 12, wherein the variable
2 compression ratio system comprises a selector valve disposed
3 between the hydraulic actuator and the hydraulic pressure
4 source, the selector valve being operative to switch supply
5 of the hydraulic pressure to the hydraulic actuator via the
6 hydraulic passage.

1 15. The method as claimed in claim 14, wherein the
2 detecting operation comprises detecting a hydraulic pressure
3 within the hydraulic passage between the selector valve and
4 the hydraulic pressure source, the method further comprising
5 comparing the detected hydraulic pressure within the
6 hydraulic passage between the selector valve and the
7 hydraulic pressure source with the predetermined hydraulic
8 pressure, the controlling operation comprising reducing the
9 hydraulic pressure within the hydraulic passage when the
10 detected hydraulic pressure within the hydraulic passage

11 between the selector valve and the hydraulic pressure source
12 is more than the predetermined hydraulic pressure.

1 16. The method as claimed in claim 15, wherein the reducing
2 operation comprises releasing an amount of hydraulic fluid
3 within the hydraulic passage between the selector valve and
4 the hydraulic pressure source when the detected hydraulic
5 pressure within the hydraulic passage between the selector
6 valve and the hydraulic pressure source is more than the
7 predetermined hydraulic pressure.

1 17. The method as claimed in claim 16, wherein the
2 predetermined hydraulic pressure is an upper limit pressure
3 within the hydraulic passage between the selector valve and
4 the hydraulic pressure source.

1 18. The method as claimed in claim 17, further comprising
2 comparing the detected hydraulic pressure within the
3 hydraulic passage between the selector valve and the
4 hydraulic pressure source with the upper limit pressure.

1 19. The method as claimed in claim 15, wherein the reducing
2 operation comprising preventing the coupling between the
3 hydraulic pressure source and the internal combustion engine.

1 20. The method as claimed in claim 15, wherein the
2 operating conditions comprise engine speed, the method
3 further comprising comparing the detected engine speed with
4 a predetermined speed, the reducing operation comprising
5 preventing the coupling between the hydraulic pressure
6 source and the internal combustion engine when the detected
7 engine speed exceeds predetermined speed.